Space Weather Technical Forecast

Issued on Monday 17 March 2025 at 12:50 Local

This technical forecast provides a four-day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: M-class flares likely. Chance G1/Minor Storms Day 1 (17 Mar). Slight chance of glancing CME (19-20 Mar). Active electron fluence.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Low with peak flare C7.8 at 17/0542 UTC from AR4028 in the southeast disc. There are thirteen regions on the Earth facing disc, however the majority of these are small and simple. The main growth has been in AR4028, with the emergence of intermediate spots, but also with a small development to the south of AR4031 in the north-centre. AR4019 in the northwest and AR4021 in the southwest, are now showing signs of simplification.

A filament eruption off the northeast disc around 16/2020 UTC appears to have produced a partial halo CME that has been deflected quite far south and west. Recent analysis suggests a slight chance of a glancing blow either late on the 19 Mar or early on 20 Mar. However, further analysis of this CME is currently on-going, with Earth-directed impacts possible.

Another filament eruption occurred at around 17/1035 UTC in the northwest quadrant, which was observed in GONG H-alpha and SDO/AIA 304 imagery. However, there is currently no coronagraph imagery available for analysis. This event will be analysed for any Earth-directed component once coronagraph imagery becomes available.

Solar Wind / Geomagnetic Activity: Solar winds, as measured by ACE and DSCOVR at L1, showed CH22/- fast winds easing. Speeds declined from slightly elevated levels of around 450 km/s to be near background, around 400km/s. Density was below average. Interplanetary Magnetic Field, Bt, was mostly weak, peaking at 8nT, with the north-south component, Bz, also weak and variable, ranging between +5/-6nT. Phi angle was mostly negative (towards the Sun). Geomagnetic activity was Quiet to Unsettled (Kp1-3).

Energetic Particles / Solar Radiation: High energy proton flux (greater than 10MeV) at GOES18 was at background levels. High energy electron flux (greater than 2 MeV) was Moderate to High, with a peak of 5060pfu at 16/1445 UTC. The 24-hour fluence was above Active (1e8 integrated pfu) throughout, reaching 1.86e8 integrated pfu at 17/0000 UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Low to Moderate activity is expected, with an ongoing likelihood of isolated M-class flares.

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Solar Wind / Geomagnetic Activity: A filament lift-off in the northeast, near the vicinity of CH24/- at 16/2020 UTC produced a partial halo CME, which appears to be heading north and east. However, after recent analysis, this looks to have been deflected southwest by CH24/-, giving us a slight chance of a glancing blow on either late on Day 3 (19 Mar), or early on Day 4 (20 Mar). However, this event is currently under-going further analysis. Otherwise, fast winds from CH22/+ have now largely eased, but with the chance for a further enhancement Day 1 (17 Mar) from any fast winds and CIR associated with CH23/-. This enhancement is low confidence, however.

Geomagnetic activity is likely to be mainly Quiet to Unsettled, with a slight chance of Active to G1/Minor Storm, if any further enhancement from CH23/- occurs on Day 1 (17 Mar). Slight chance of Active to G1/Minor storm late on Day 3 (19 Mar) and Day 4 (20 Mar) with the slight chance of a glancing CME arrival (from the 16 Mar). Low confidence.

Energetic Particles / Solar Radiation: High energy proton flux is expected to be at background levels, with a slight chance of enhancement should there be any larger flares. High energy electron flux is expected to continue to reach high levels at the diurnal maxima, with Active (1e8 integrated pfu) fluence continuing Days 1-2 (17-18 Mar) before potentially easing. Confidence lowers later in the period.

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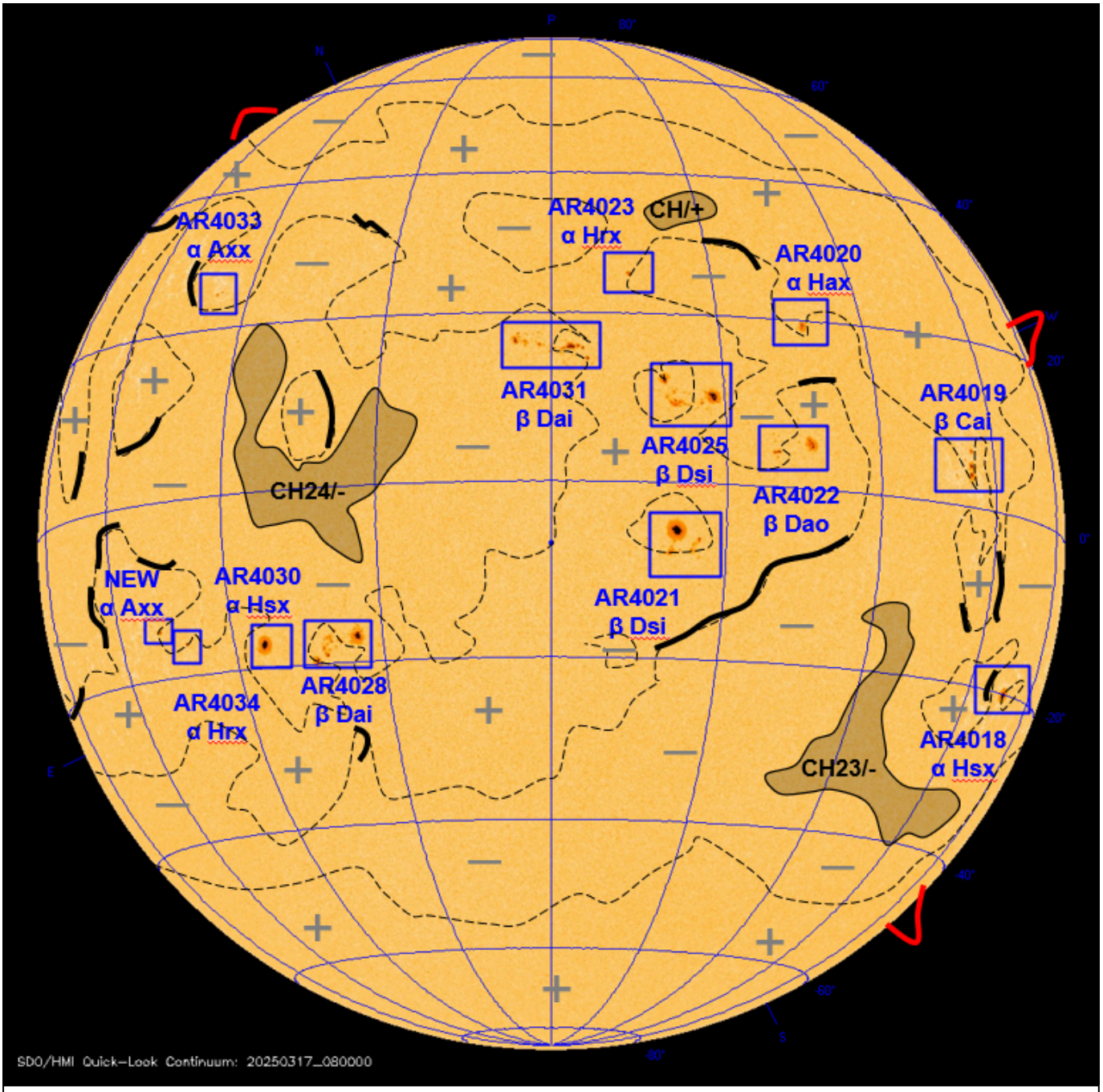
Figure 1: MOSWOC Solar Synoptic Map 17/0800 UTC



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms

A filament eruption which occurred in the northeast quadrant, within the vicinity of CH24/-, at 16/2020 UTC produced a partial halo CME in coronagraph imagery, with an associated shock evident. This has been analysed, as results suggest a slight chance of a glancing blow arriving at Earth either late on Day 3 (19 Mar) or early on Day 4 (20 Mar), although confidence is low. Further analysis of this event is currently on-going. Given the filament was near CH24/-, there may have been some deflection towards the south and west, which is currently under consideration.

Otherwise, the fast wind enhancement from CH22/- has now eased with solar wind speeds near background at around 400km/s . However, a further potential enhancement remains possible during Day 1 (17 Mar). This is due to any fast wind from the northern extension of CH23/-, the leading edge of which is located around 35W, and with potential wind speeds of 450-550km/s, this would likely result in any CIR onset through Day 1 (17 Mar).

This is low confidence however, both due to the feature being located further south than CH22/- which brought the more recent enhancement, but also as this feature was observed only as a continuation of the previous fast wind enhancement as a single feature on the previous solar rotation. Furthermore MOSWOC Enlil suggests solar winds should be easing through 17-18 Mar, towards the background speeds that are currently being observed.

Mainly Quiet to Unsettled activity is expected, however any further fast wind enhancement from CH23 brings the chance for a spell of Active to G1 Minor Storms. There is a slight chance of a further enhancement from a glancing CME (which left the Sun on 16 Mar) on Days 3 and 4 (19-20 Mar), which could give another period of Active to G1/Minor Storm intervals. Low confidence.

Geomagnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	**G1 to G2**	No	20	5	10	20
Strong	**G3**	No	1	1	1	1
Severe	**G4**	No	1	1	1	1
Extreme	**G5**	No	1	1	1	1

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Figure 2: MOSWOC ENLIL - shows a possible glancing CME on 19-20 March.

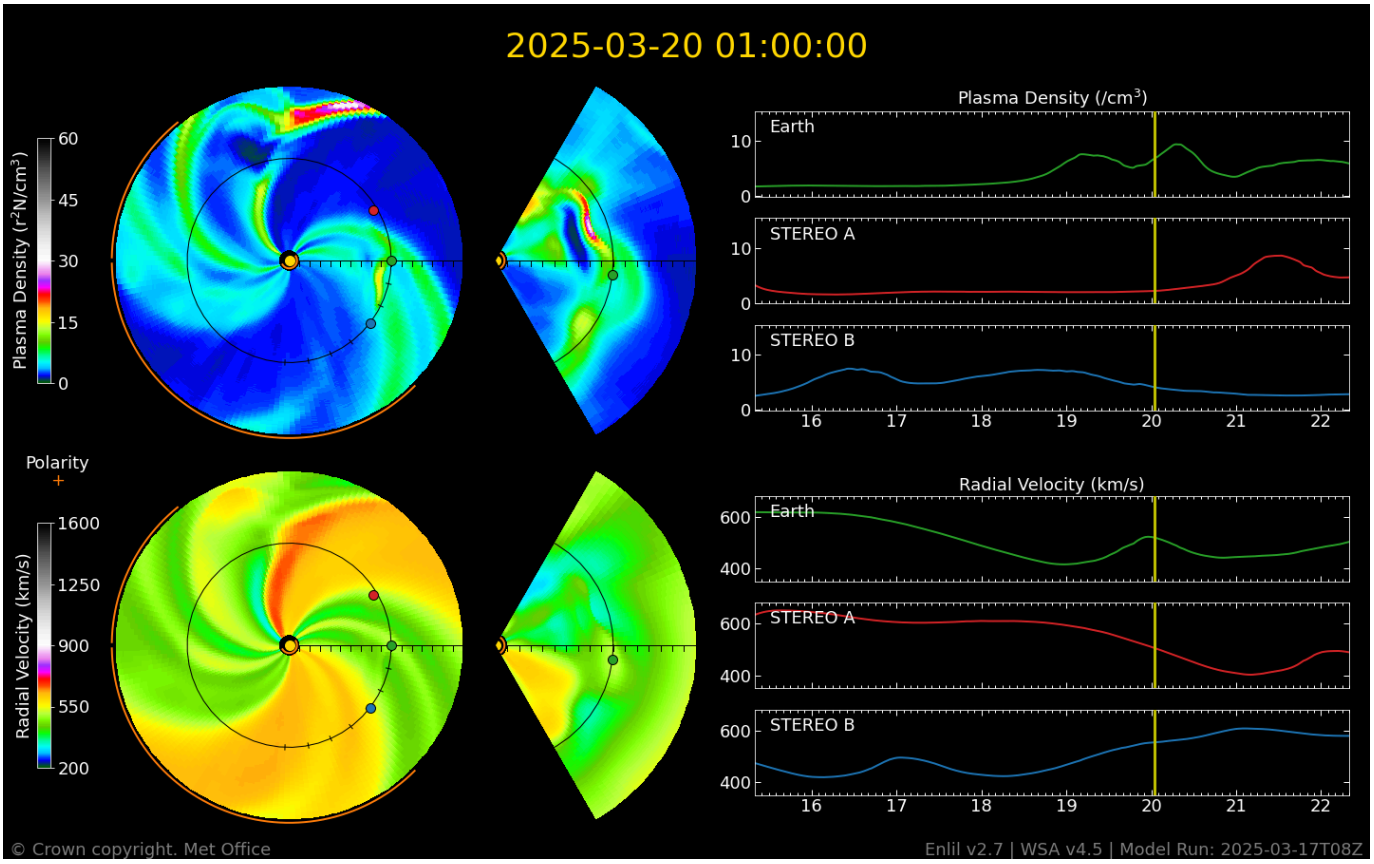

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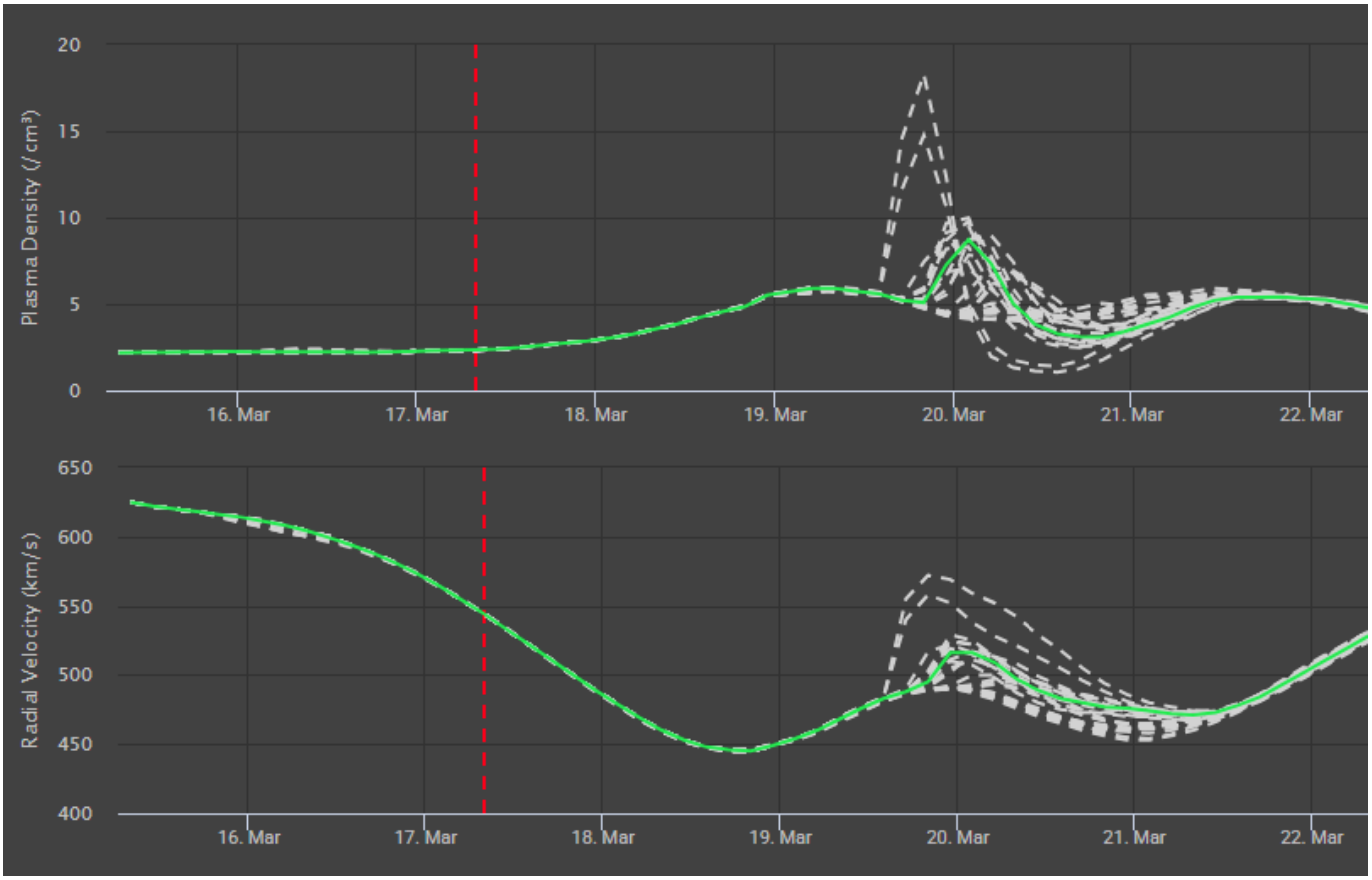
Figure 3: ENLIL Ensemble - shows possible arrival times for a glancing CME (from the 16 Mar).



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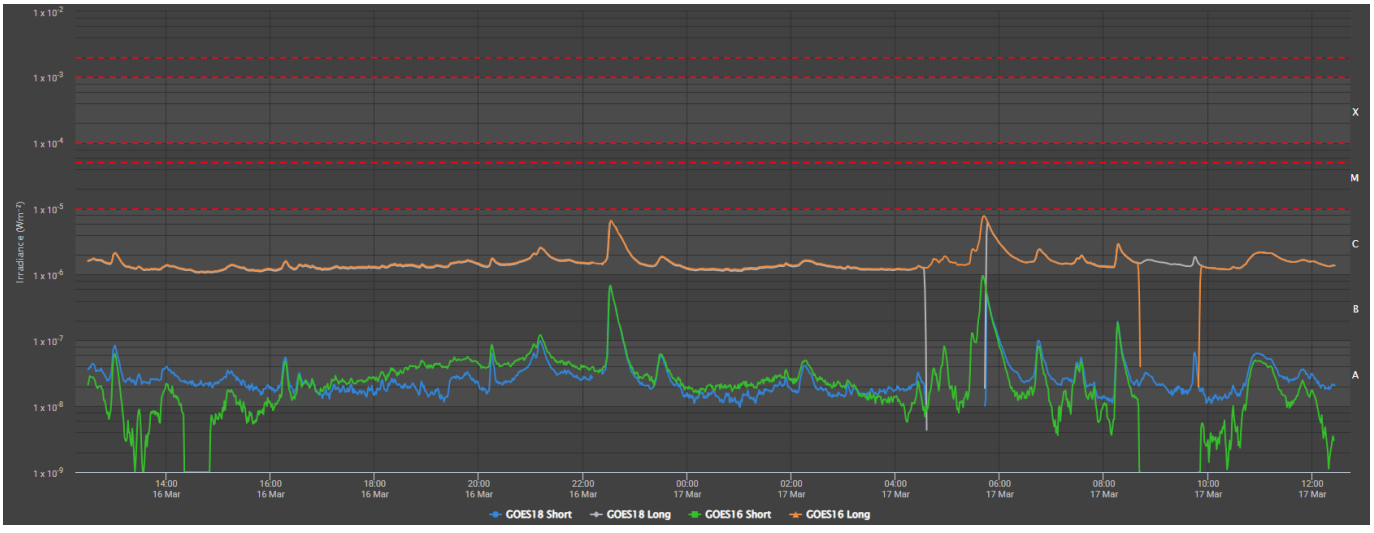
Radio Blackouts - X-Ray Flares

There are thirteen sunspot regions on the visible disc, however these are generally small and relatively simple in structure, with activity expected to be Low to Moderate with a likelihood for isolated M-class flares.

Growth of these regions has been sporadic, with the most recent development observed in AR4028 in the southeast and AR4031 in the northeast. AR4028 is a a simple bipolar region, but with ongoing emergence of intermediate spots, while AR4031 has seen a small bipolar pair of spots emerge on its southwestern periphery, leading to a more complex structure. AR4019 and AR4021 continue to be of some interest, due to their slightly unusual configuration and previous slight development, although these continue to show signs of decline. The other regions of note are AR4022 and AR4025, now in the northwest disc, as while simple bipolar groups, these continue to show fluctuations in development. There is also some sign of further potential regions soon to rotate onto the northeast and southeast limbs, with bright looping evident on SDO aia-94.

X-Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 (M Class)	No	50	60	60	60
Very Active	R3-R5 (X Class)	No	5	5	5	5

Figure 4: GOES16-18 X-Ray Flux



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Solar Radiation Storms (High Energy Protons)

GOES18 high energy (>10MeV) proton flux is expected to remain at background levels, with only a slight chance of enhancement due to the current inactivity and magnetic simplicity of the small regions on the Earth-facing disc.

Radiation Storms Probability (Exceedance)	Level ($cm^{-2}sr^{-1}s^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	10	10	10	10
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and/or 50 MeV ≥ 10pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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High Energy Electrons (≥ 2MeV)

GOES16 High energy (>2MeV) Electron flux has been varying between Moderate and High on the satellites diurnal cycle, as a result of the recent connection to the fast wind from CH22/- and the subsequent outward expansion of the charged Van Allen belts as this wind eases. A brief drop out is possible on Day 1 (17 Mar) alongside any increase in the solar wind pressure from the onset of any further enhancement from the fast wind from CH23/-, however this is low confidence. Otherwise, the flux is expected to continue varying diurnally between Moderate and peak High, but with both the period of High flux and peak values are expected to gradually decrease later in the period.

The associated 24 hour fluence is expected to continue above Active (1e8 integrated pfu) at first, but with lower confidence for this to persist into Days 3-4 (19-20 Mar). A declining trend is supported by both 27 day persistence and MOSWOC REFM, with observations currently lying between these two models, however these do not take account of any further enhancement that may occur from a possible glancing CME (19-20 Mar), and are also currently showing a declining trend, while observations are rising. This lowers confidence in this forecast.

GEO Electron Environment	Level ($cm^{-2}sr^{-1}$ day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ 1×10^{8}	Yes	100	70	30	20
Very Active	≥ 2 MeV ≥ 1×10^{9}	No	1	1	1	1

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Figure 5: MOSWOC REFM Electron Fluence - currently above the Active threshold.

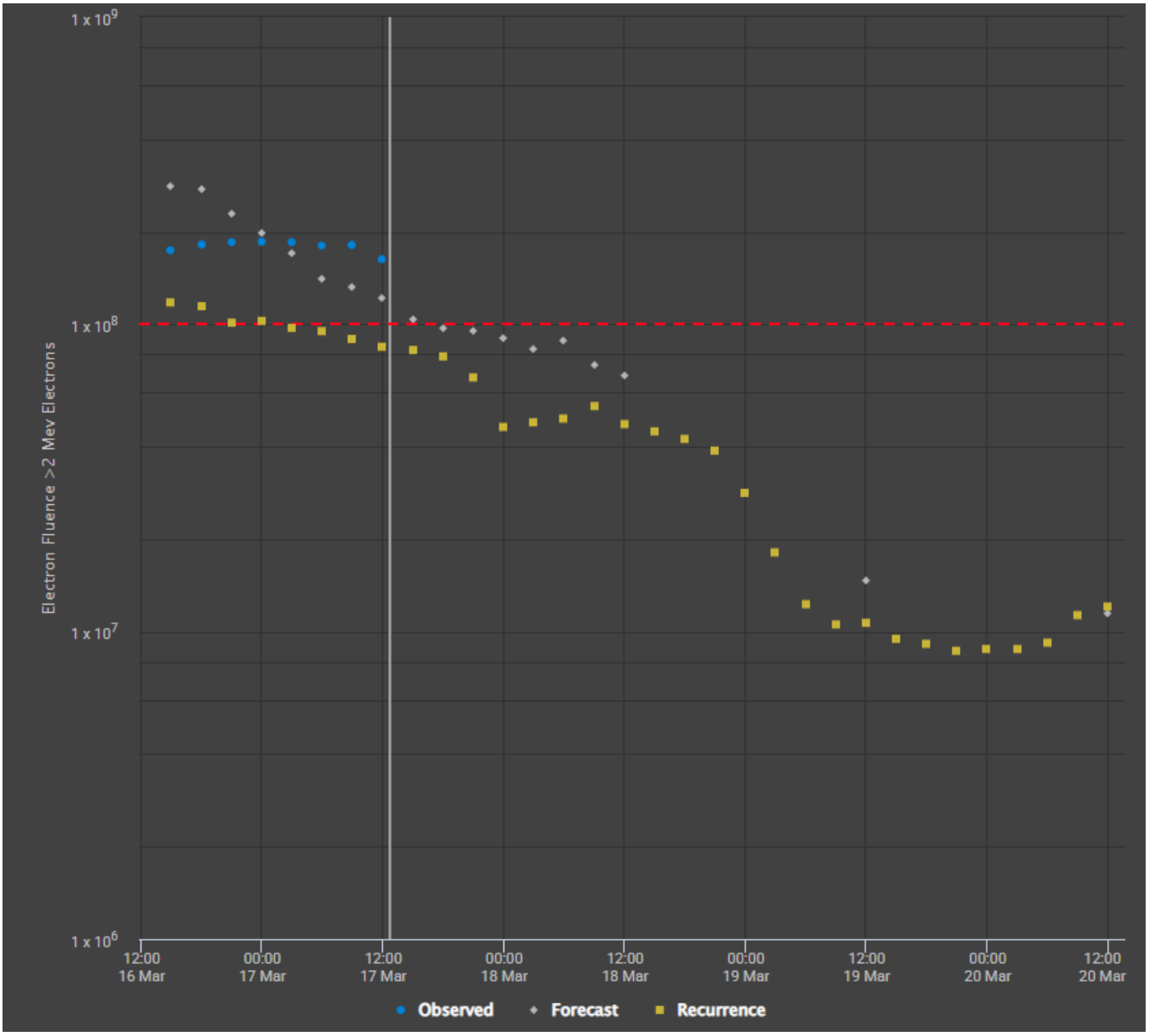

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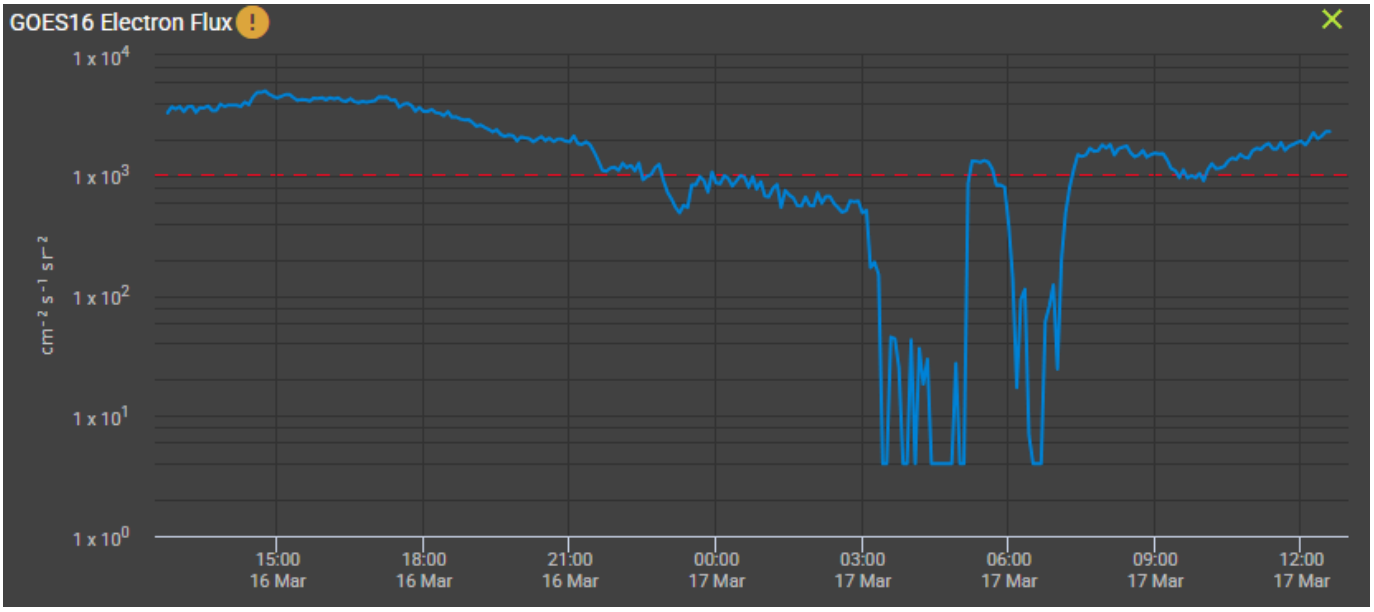
Figure 6: GOES16 Electron Flux



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